NPN Silicon Power Darlington Transistors

MJE5740, MJE5742

The MJE5740 and MJE5742 Darlington transistors are designed for high−voltage power switching in inductive circuits.

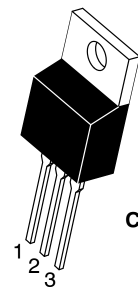
Features

- These Devices are Pb−Free and are RoHS Compliant*

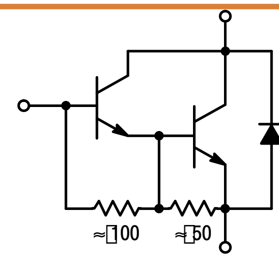
Applications

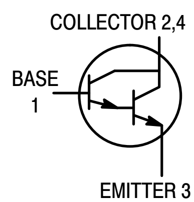
- Small Engine Ignition
- Switching Regulators
- Inverters
- Solenoid and Relay Drivers
- Motor Controls

**POWER DARLINGTON TRANSISTORS
8 AMPERES
300−400 VOLTS
80 WATTS**

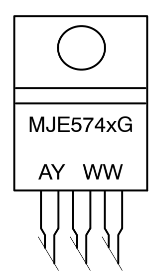


**TO−220AB
CASE 221A−09
STYLE 1**





MARKING DIAGRAM



MJE574x	=	Device Code x = 0 or 2
G	=	Pb−Free Package
A	=	Assembly Location
Y	=	Year
WW	=	Work Week

MAXIMUM RATINGS

Symbol	Rating	Value	Unit
$V_{CEO(sus)}$	Collector−Emitter Voltage MJE5740 MJE5742	 300 400	Vdc
V_{CEV}	Collector−Emitter Voltage MJE5740 MJE5742	 600 800	Vdc
V_{EB}	Emitter−Base Voltage	8	Vdc
I_C I_{CM}	Collector Current − Continuous − Peak (Note 1)	8 16	Adc
I_B I_{BM}	Base Current − Continuous − Peak (Note 1)	2.5 5	Adc
P_D	Total Device Dissipation @ T_A = 25°C Derate above 25°C	2 0.016	W W/°C
P_D	Total Device Dissipation @ T_C = 25°C Derate above 25°C	100 0.8	W W/°C
T_J, T_{stg}	Operating and Storage Junction Temperature Range	−65 to +150	°C

THERMAL CHARACTERISTICS

Symbol	Characteristics	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case	1.25	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient	62.5	°C/W
T_L	Maximum Lead Temperature for Soldering Purposes 1/8″ from Case for 5 Seconds	275	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Pulse Test: Pulse Width = 5 ms, Duty Cycle ≤ 10%.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Characteristic		Min	Typ	Max	Unit
OFF CHARACTERISTICS (Note 2)						
$V_{CEO(sus)}$	Collector−Emitter Sustaining Voltage (I_C = 50 mA, I_B = 0)	MJE5740 MJE5742	300 400	– –	– –	Vdc
I_{CEV}	Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc) (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, T_C = 100°C)		– –	– –	1 5	mAdc
I_{EBO}	Emitter Cutoff Current (V_{EB} = 8 Vdc, I_C = 0)		–	–	75	mAdc
SECOND BREAKDOWN						
$I_{S/b}$	Second Breakdown Collector Current with Base Forward Biased		See Figure 6			
RBSOA	Clamped Inductive SOA with Base Reverse Biased		See Figure 7			
ON CHARACTERISTICS (Note 2)						
h_{FE}	DC Current Gain (I_C = 0.5 Adc, V_{CE} = 5 Vdc) (I_C = 4 Adc, V_{CE} = 5 Vdc)		50 200	100 400	– –	–
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage (I_C = 4 Adc, I_B = 0.2 Adc) (I_C = 8 Adc, I_B = 0.4 Adc) (I_C = 4 Adc, I_B = 0.2 Adc, T_C = 100°C)		– – –	– – –	2 3 2.2	Vdc
$V_{BE(sat)}$	Base−Emitter Saturation Voltage (I_C = 4 Adc, I_B = 0.2 Adc) (I_C = 8 Adc, I_B = 0.4 Adc) (I_C = 4 Adc, I_B = 0.2 Adc, T_C = 100°C)		– – –	– – –	2.5 3.5 2.4	Vdc
V_f	Diode Forward Voltage (Note 3) (I_F = 5 Adc)		–	–	2.5	Vdc

SWITCHING CHARACTERISTICS

Symbol	Characteristic	Conditions	Min	Typ	Max	Unit
Typical Resistive Load (Table 1)						
t_d	Delay Time	(V_{CC} = 250 Vdc, $I_{C(pk)}$ = 6 A I_{B1} = I_{B2} = 0.25 A, t_p = 25 μs, Duty Cycle ≤ 1%)	–	0.04	–	μs
t_r	Rise Time		–	0.5	–	μs
t_s	Storage Time		–	8	–	μs
t_f	Fall Time		–	2	–	μs
Inductive Load, Clamped (Table 1)						
t_{sv}	Voltage Storage Time	($I_{C(pk)}$ = 6 A, $V_{CE(pk)}$ = 250 Vdc I_{B1} = 0.06 A, $V_{BE(off)}$ = 5 Vdc)	–	4	–	μs
t_c	Crossover Time		–	2	–	μs

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Pulse Test: Pulse Width 300 μs, Duty Cycle = 2%.
3. The internal Collector−to−Emitter diode can eliminate the need for an external diode to clamp inductive loads. Tests have shown that the Forward Recovery Voltage (V_f) of this diode is comparable to that of typical fast recovery rectifiers.

TYPICAL CHARACTERISTICS

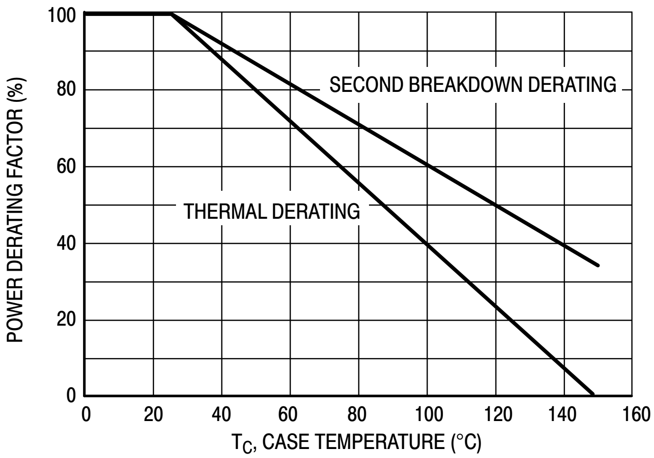


Figure 1. Power Derating

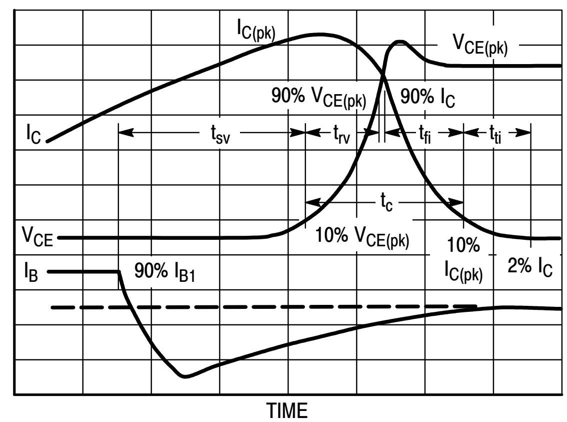


Figure 2. Inductive Switching Measurements

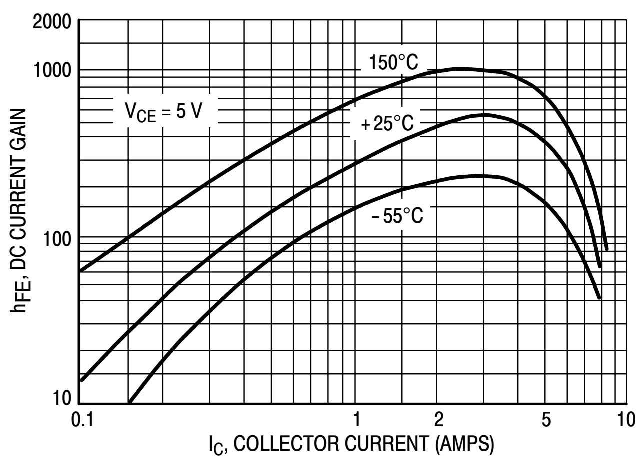


Figure 3. DC Current Gain

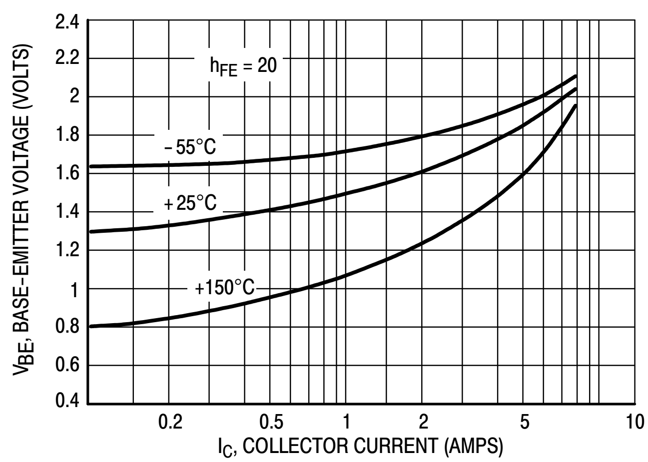


Figure 4. Base−Emitter Voltage

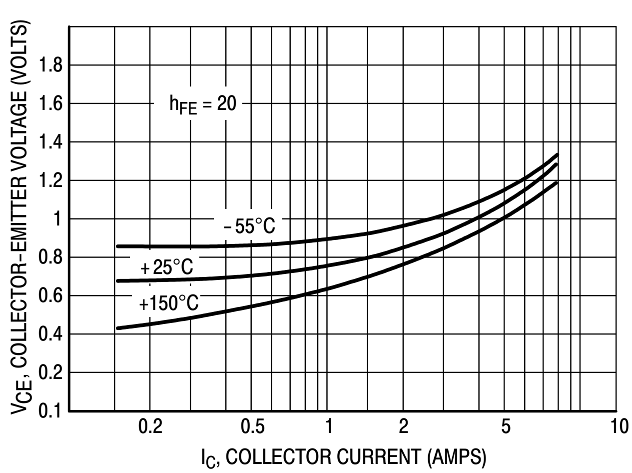
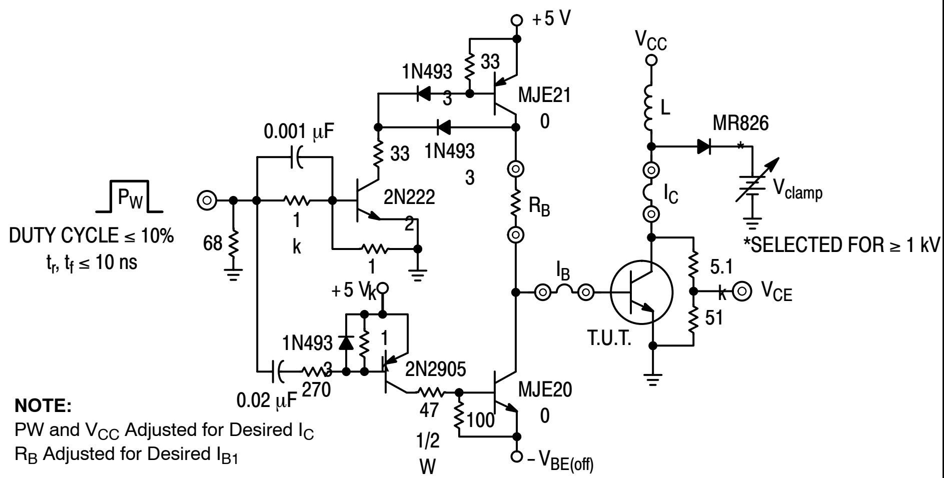
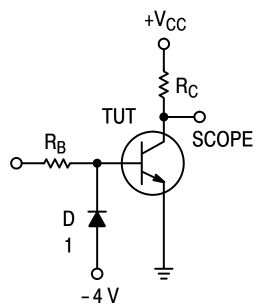
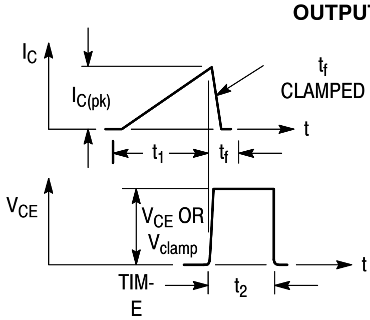
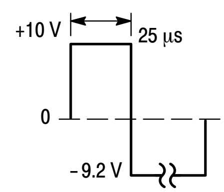


Figure 5. Collector−Emitter Saturation Voltage

Table 1. Test Conditions for Dynamic Performance

	REVERSE BIAS SAFE OPERATING AREA AND INDUCTIVE SWITCHING	RESISTIVE SWITCHING
TEST CIRCUITS	 **NOTE:** PW and V_{CC} Adjusted for Desired I_C; R_B Adjusted for Desired I_{B1}	
CIRCUIT VALUES	COIL DATA: FERROXCUBE CORE #6656 FULL BOBBIN (~16 TURNS) #16 — GAP FOR 200 μH/20 A, L_{coil} = 200 μH — V_{CC} = 30 V, $V_{CE(pk)}$ = 250 Vdc, $I_{C(pk)}$ = 6 A	V_{CC} = 250 V; D1 = 1N5820 OR EQUIV.
TEST WAVEFORMS	**OUTPUT WAVEFORMS**  t_1 ADJUSTED TO OBTAIN I_C; $t_1 \approx \frac{L_{coil}(I_{Cpk})}{V_{CC}}$; $t_2 \approx \frac{L_{coil}(I_{Cpk})}{V_{clamp}}$ — TEST EQUIPMENT SCOPE-TEKTRONICS 475 OR EQUIVALENT	 t_r, t_f < 10 ns; DUTY CYCLE = 1%; R_B AND R_C ADJUSTED FOR DESIRED I_B AND I_C

SAFE OPERATING AREA INFORMATION

FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on $T_C = 25°C$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geq 25°C$. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 6 may be found at any case temperature by using the appropriate curve on Figure 1.

REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn−off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage−current condition allowable during reverse biased turnoff. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives the complete RBSOA characteristics.

The Safe Operating Area figures shown in Figures 6 and 7 are specified ratings for these devices under the test conditions shown.

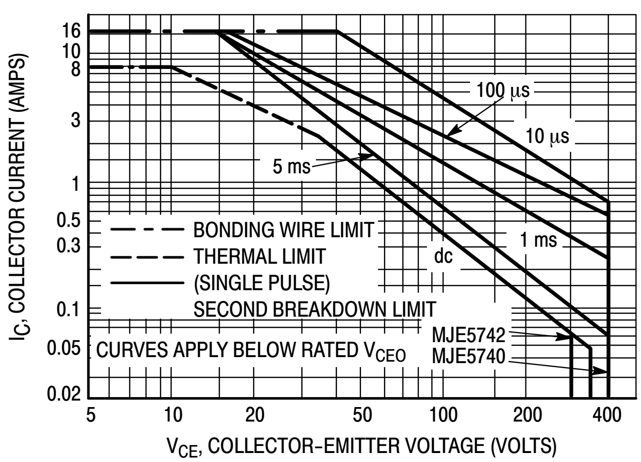


Figure 6. Forward Bias Safe Operating Area

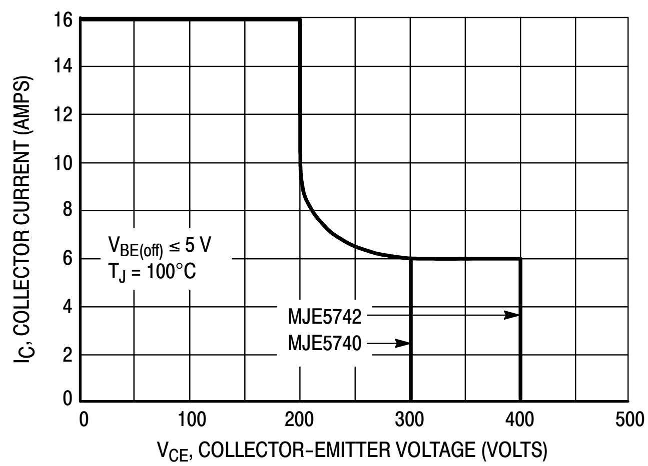


Figure 7. Reverse Bias Safe Operating Area

RESISTIVE SWITCHING PERFORMANCE

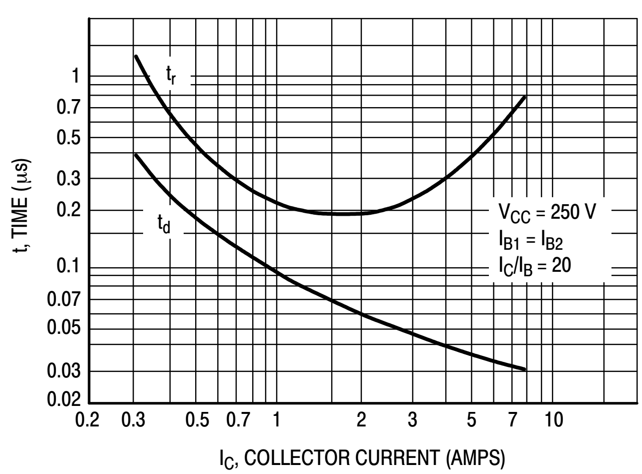


Figure 8. Turn−On Time

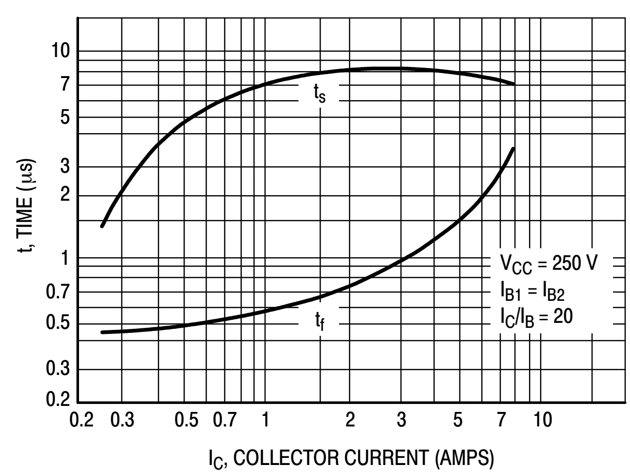


Figure 9. Turn−Off Time

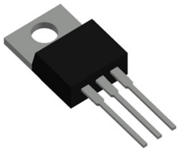
ORDERING INFORMATION

Device	Package	Shipping
MJE5742G	TO−220 (Pb−Free)	50 Units / Rail

DISCONTINUED (Note 4)

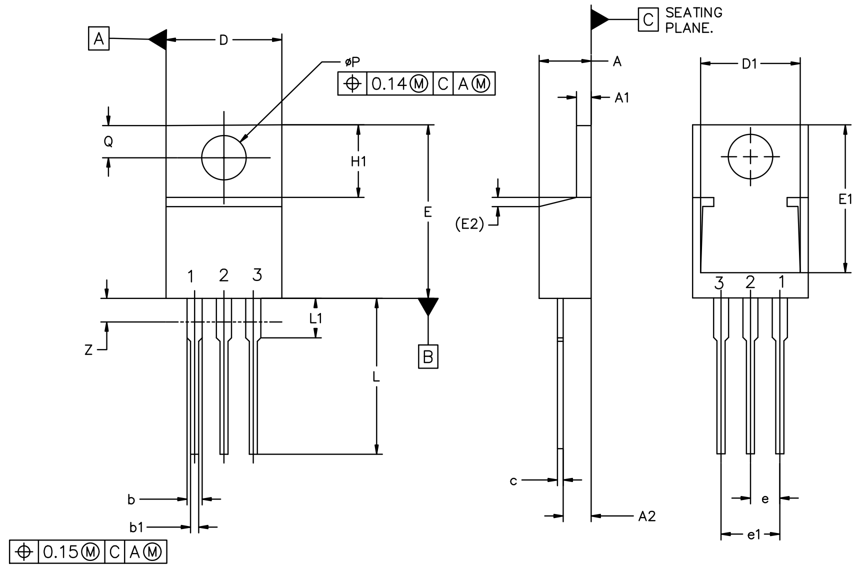
MJE5740G	TO−220 (Pb−Free)	50 Units / Rail

4. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on www.onsemi.com.



TO−220−3 10.10x15.12x4.45, 2.54P
CASE 221A
ISSUE AL

DATE 05 FEB 2025



MILLIMETERS			
DIM	MIN	NOM	MAX
A	4.07	4.45	4.83
A1	1.15	1.28	1.41
A2	2.04	2.42	2.79
b	1.15	1.34	1.52
b1	0.64	0.80	0.96
c	0.36	0.49	0.61
D	9.66	10.10	10.53
D1	8.43	8.63	8.83
E	14.48	15.12	15.75
E1	12.58	12.78	12.98
E2	1.27 REF		

MILLIMETERS			
DIM	MIN	NOM	MAX
e	2.42	2.54	2.66
e1	4.83	5.08	5.33
H1	5.97	6.22	6.47
L	12.70	13.49	14.27
L1	2.80	3.45	4.10
Q	2.54	2.79	3.04
øP	3.60	3.85	4.09
Z	−.−−	−.−−	3.48

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR
4. EMITTER

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED

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